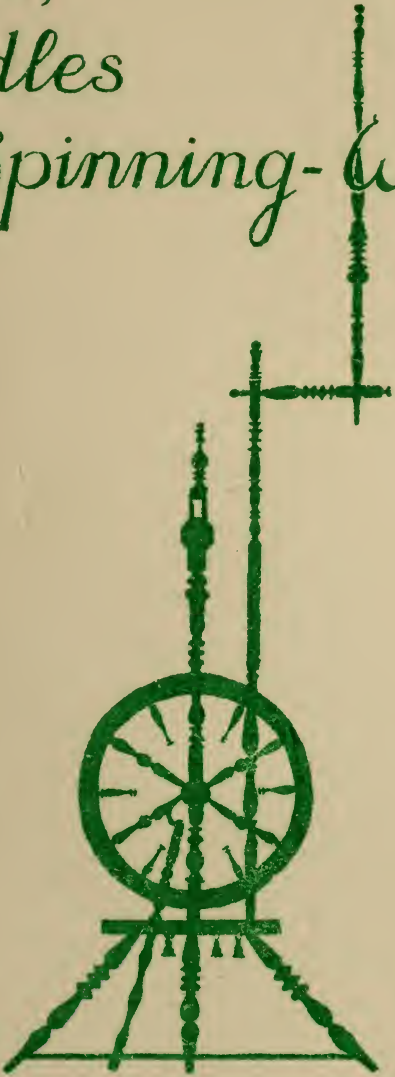
ARCHIVES Royal Ontario Museum

Fibres, Spindles and Spinning-Wheels



Royal Ontario Museum
of Archaeology

Digitized by the Internet Archive
in 2014

https://archive.org/details/fibresspindlessp00burn

Fibres, Spindles and Spinning-Wheels

By

Dorothy K. Macdonald

Royal Ontario Museum of Archaeology

First Published - 1944

Second Edition - 1950

INTRODUCTION

The textile arts are second in importance only to agriculture and like agriculture, made their earliest appearance during the Neolithic or New Stone Age, when people first started to lead a settled life. This stage of culture was reached in various parts of the world at different times. In Europe men had developed to this point 15,000 years ago, while the Indians of North America were still in the Neolithic Age when the white man came to this country.

The first step in making a piece of cloth comes long before the weaving. A textile fibre must be procured and prepared for use, and only fibres which have certain properties are suitable for textile purposes. In the first place, they must have strength and durability. Cotton and milk-weed, for example, both have seed pods with hairs attached to the seeds; but, since the individual seed-hairs of the cotton plant have strength, it is one of our most useful natural fibres, while those of milk-weed have little tensile strength and are of little use. The length, pliability, uniformity, and cohesive properties of the fibres are also all of great importance in spinning a thread. In primitive times men made use of any textile fibre, animal or vegetable, that was readily available. It was soon found, however, that certain plants and animals provided fibres more suitable for spinning and weaving than others, and the use of these better materials gradually extended until the four most common fibres, wool, linen, cotton and silk were generally employed almost wherever possible.

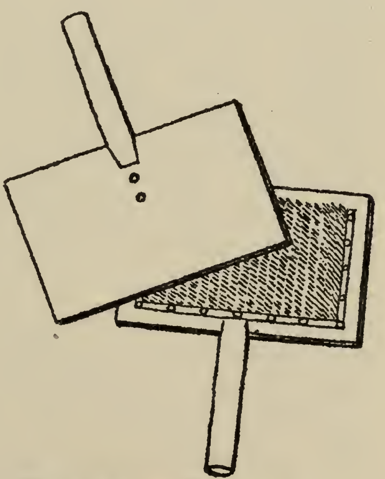
Dog used for wool by British Columbia Indians

WOOL

Wool was one of the first fibres used by man. We usually think of sheep when we speak of wool, but there are many other animals that are useful in this respect - goats and camels are very generally used. The native wool-bearing animals of South America are of the llama family; ancient fabrics made of wool from these camel-like animals can be seen in the Peruvian Gallery, Ground Floor. Bison wool was used by the early inhabitants of North America, and on the west coast of Canada a special variety of the dog was domesticated for this purpose. The drawing shows one of these dogs, taken from a painting by Paul Kane in the Museum. On the west coast they also used the wool of the mountain goat; a heavy blanket in the British Columbia Gallery, Ground Floor, is woven of what is probably a mixture of dog and mountain goat wool.

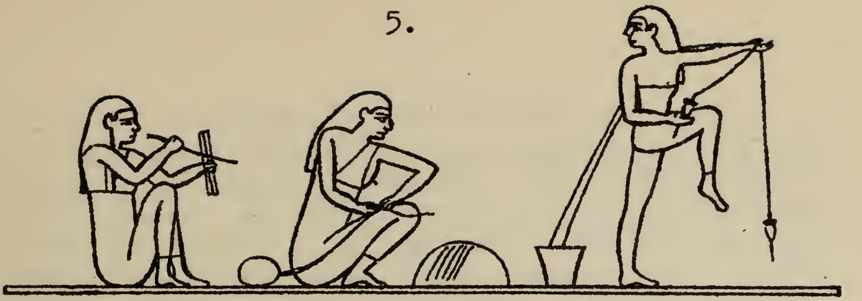
The sheep was domesticated very early in man's history. Originally it was, like many other animals, hairy with a downy undercoat of wool. Through centuries of careful breeding the wool was increased, until sheep were covered entirely with it, however old and neglected sheep sometimes revert to their original state and become hairy.

Wool has to go through many stages before it is ready for weaving. The sheep is shorn and, as each fleece has many different lengths and qualities of fibre in it, it has to be carefully sorted into types. Wool as it comes from the sheep is greasy and full of burrs and tangles, so it must be washed and combed. The combing, fluffing it out, and removing burrs must originally all have been done with the hands alone, then combs were made, and later implememts called "cards" came into use. A card looks like this drawing. The board part is covered with leather and set with rows of sharp pins. In the operation of carding wool, one card is held firmly in the left hand points uppermost, a bit of the washed wool is placed on it, and the other card is drawn repeatedly across it with the right hand, until the wool is free of burrs and tangles. The wool is then removed from the cards, and made into a loose roll ready for spinning. This is the way wool was prepared until the time of the Industrial Revolution when carding



Pair of wool cards

machines were invented. They work on the same principle as hand cards, but the pins are set on large rollers and a great deal of wool can be fed into them at once. Since mediaeval times the preparation of wool for the loose fluffy types of cloth, knitting wools etc., has been divided sharply from the process used for the wool destined for harder types of cloth, which are called worsteds. Sheep's wool comes in fibre lengths ranging from about two to twelve inches. As a rule the shortest fibres are used for making felt, the medium lengths are carded into loose rolls which are suitable for spinning fluffy wools, while the longest fibres, which are destined for worsteds, are set aside, and instead of being carded in the usual way, are combed so that the fibres all lie parallel. Long fibres, prepared in this way, can be spun into a very smooth hard thread, which is much better adapted to the weaving of suit and coat materials than the softer types of carded wools.



FLAX

From the flax plant we get linen, which is thought to be the first textile fibre used in the Mediterranean world. Bundles of prepared flax and cloth woven of linen thread, have been found in the excavation of Neolithic sites on the Swiss Lakes, which means that linen was being spun and woven in Europe some 15,000 years ago. We have only to read the Old Testament to realize the part that linen played in biblical times, for the mention of "fine linen" is very frequent. In Egypt the flax plant has been cultivated for at least 7,000 years, and in the Egyptian Galleries, Second Floor, there are linen shawls woven about 2,000 years before Christ. The mummy wrappings also show the fine linen weaving for which Egypt was famous. The drawing above is taken from an Egyptian wall picture and shows three stages in the making of flax fibres into linen thread. The figure on the left is cleaning the fibres, in the centre they are being loosely rolled together, and the woman on the right is busy spinning two threads at a time and calling to her assistants to hurry.

All down through history linen has played an important part, reaching its peak of technical perfection in the linen thread used to make the fine laces of the 18th century. Many of these cobwebby laces are shown in the Textile Galleries, Second Floor.

There are three classes of vegetable fibres. The two main ones are seed-hairs, the fluff whereby seeds are scattered on the wind, and bast fibres, which come from the stems of certain plants. Cotton is a fibre of the former type while linen, hemp, jute and ramie are bast fibres. Vegetable fibres that come from leaves of plants - raffia palm, pineapple etc. form the third type. These leaf fibres are used locally in many parts of the world, but have little commercial importance, except in rope making.

Flax produces the most important and best of the bast fibres. The plant that is used now is an annual which is indigenous to the district, lying between the Persian Gulf, the Caspian and the Black Seas. It has an erect stalk twenty to forty inches high which branches at the top, and has bright blue flowers. In harvesting and preparing flax, the plants are first pulled up by the roots, then the stalks are stripped of leaves and flowers. The next step is called retting, and consists of rotting the stems. The most usual method is Pool Retting; in it bundles of the stalks are sunk in pools of stagnant water and left till the woody part of the stem rots, which usually takes a couple of weeks. The same end is achieved in Dew Retting, by spreading the stalks out over the fields and leaving them until retted by sun and dampness. After retting, the stalks are broken, skutched and combed; in these processes the decomposed wood is removed leaving the fine linen fibres clean and ready for spinning. Until recently all these processes were carried on in a very primitive way and in many places they still are, but there are now machines for pulling flax which do away with much of the hard labour of harvesting, and simplified ways of retting the flax have been developed.

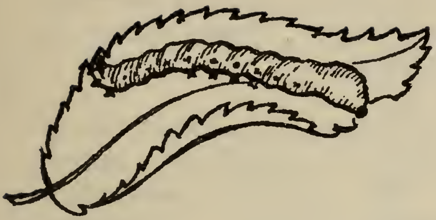
COTTON

Cotton came originally from India and has been found in excavations that date back to 2,500 B.C. or earlier. Its cultivation probably spread slowly from India to Central Asia and later to China and Japan. At an early date the plant was being grown in the Near East, and from there was carried by the Mohammedans across North Africa and up into Spain during the 8th century. Gaily flowered cottons, the ancestors of our modern chintzes, were one of the main items of commerce brought to Europe by the various East India Companies, during the 17th and 18th centuries. Many examples of these exquisite early, chintzes are in the Museum's textile collection.

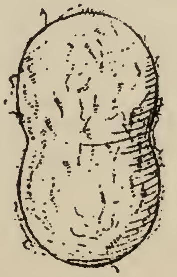
The cotton plant is also native to the tropical and sub-tropical parts of the western hemisphere, and was the main fibre used by the Mayas in their weaving. When Christopher Columbus touched at Watling Island in 1492 the Indians brought skeins of cotton thread out to his ship to trade. It was not until after the American Revolution that cotton growing started on a large scale in the United States, now the most important cotton producing country in the world.

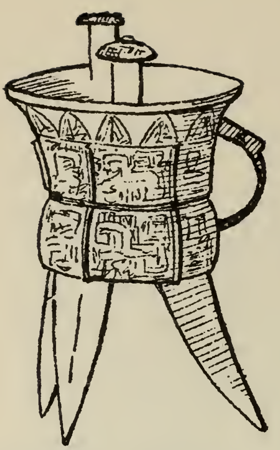
Cotton, a member of the mallow family, is a small bush with seeds that grow in bolls. Attached to the seed is a soft white downy fibre, ranging from about one half to two inches in length, which can readily be spun. The most important process in preparing cotton for use is in separating these fibres from the seeds. In the western world this was done by hand until the 19th century, but in the East there was invented, at an early date, a simple device, rather like a mangle, into which the cotton was fed, the fibres going through while the seeds remained. At the end of the 18th century, Eli Whitney, an American, invented his cotton "gin". The term "gin" is simply an abbreviation for the word "engine". In Whitney's "gin", the cotton fibres are pulled through a grating, which has too small a mesh to allow the seeds to pass. Whitney's invention revolutionized the American cotton industry, as in the United States, until that time, cotton was separated entirely by hand, and it took one worker a whole day to pick over a pound of cotton. In modern industry there are two types of cotton ginning machinery; the roller gin which was developed from the ancient eastern mangle-like device, and the saw gin which is descended from Whitney's invention.

SILK



Silk has for many centuries been the luxury fibre of the world. It comes from the cocoons spun by various types of moth caterpillars. The silk produced by one variety, which is called Bombyx mori and is native to China, is better than that of any other type of silk-worm. The caterpillar is shown at the top of the page and the drawing below shows the cocoon of the Chinese silk-worm. The legend regarding the discovery of the use of silk is that nearly 5,000 years ago, an Empress of China, the Lady of Hsi-ling, out of curiosity, experimented with one of the wild silk-worms in her garden, and found that with infinite patience, she could unwind the fine filament of its cocoon. She and her ladies then discovered, that by combining many filaments together, they could get a thread heavy enough to use for sewing or weaving. Although this is no more than a legend, sericulture, as the raising of silk-worms and the preparation of silk is called, was well established in China by 1300 B.C. No actual fabrics of that time have survived, but we can tell very well what they were like, because many of the bronze vessels of that period were buried in the graves wrapped, or covered, with fine silk cloth, and during the centuries, although most of the fabrics have rotted away, parts of some of them have been preserved by the permeation of bronze corrosion, and the cloth is still plainly visible and the fibres can be identified as silk. An excellent example of this can be seen on one of the knobs

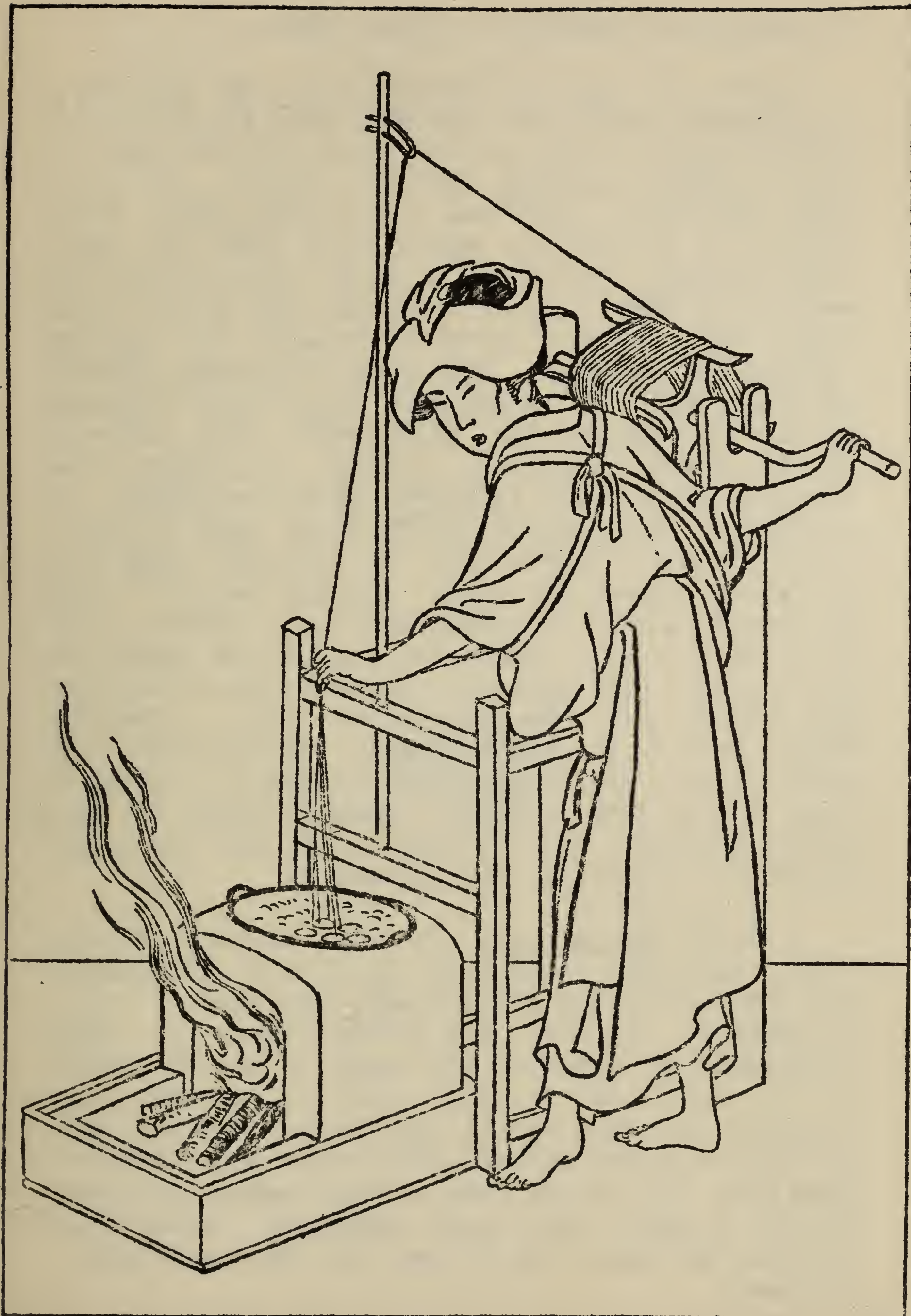




Chinese, c.1300 B.C.

protruding from the largest vessel in the "Elephant Tomb" group in the Chinese section of the Museum, and shown in this picture.

The Chinese guarded their knowledge of sericulture carefully, but exported quantities of finished silken fabrics. During Roman times there were regular caravan routes across Asia, as well as a good deal of sea traffic, which carried silk from the East to satisfy the craving for luxury of the wealthy Romans. Silk was literally worth its weight in gold by the time it reached the west, for it passed through many hands on its long journey, and at each stage a heavy profit was taken. Although the Romans dressed in silk, they still had no idea of how the beautiful fibre was obtained, but slowly, in spite of all the Chinese could do to guard their secret, the knowledge of sericulture spread, first to Central Asia, and then down into India. Finally in the 6th century A.D., two Christian missionaries returning to Constantinople from Central Asia brought with them, as a present to the Emperor Justinian, a supply of silk-worm eggs and the knowledge of how to carry through the various processes of sericulture. From that time the culture of the silk-worm spread slowly through the Mediterranean world, to Syria, then to Spain, Sicily and Italy and finally during the 17th century, it became firmly established in France. Sericulture can only be carried on in a warm climate where mulberry trees grow well, for that is the main food of the best varieties of silk-worm. As the climate of England was not suitable, James I tried to make the colonists in Virginia raise silk-worms,



Reeling silk – From a Japanese print by Utamaro but they much preferred to grow tobacco.

When the eggs are hatched the worms are tiny, but between that time and when they start to spin their cocoons, they are fed five or six times a day on freshly picked mulberry leaves, and they grow enormously, bursting out of their skins four times. At the end of a month they start to spin their cocoons, which takes about three days. The worm first makes a loose covering for itself. and then starts to work from the outside in, winding its way up and down, producing an unbroken stream of liquid silk which hardens into a fine filament. The larvae are usually killed with heat as soon as the cocoon is spun, in order to prevent the breaking of the silk filament by the emergence of the moth. The tedious and exacting task of reeling the silk is carried out by putting about ten or twelve cocoons in almost boiling water. The hot water melts the gluey substance which holds the fibres and a loose end can then be found to each cocoon. The operator gathers these together and unwinds all the cocoons at once. Usually about four to six hundred yards can be reeled off each cocoon. The illustration on page 11 is taken from a late 18th century Japanese print by the artist Utamaro, and it shows the time honoured method of performing this operation.

Beside Bombyx mori, the best variety of silk worm, there are many other species of cultivated and semi-cultivated caterpillars that produce silk. In parts of the East the broken cocoons of wild silk-worms are gathered and these, as well as parts of the cultivated cocoons that are not fit for reeling, are torn up and spun in just the same way as wool or cotton or any of the other short fibres. Spun silk is not as fine as the reeled silk, but it can be made into very beautiful materials, examples of which can be seen in the Museum collections.

The thread that is produced from the reeling, even though it is made up from the filaments of eight to twelve cocoons, is too light for any practical purpose, so it must be combined and twisted with other threads before it can be used. This is called silk throwing and it is an important process in the preparation of silk. Throwing can be done with a hand spindle or spinning-wheel in the way that any threads are combined to make a two or three ply yarn, but about the 13th century in Italy a silk throwing mechanism was invented, which made it possible to twist many silk threads at once. The quality of silk used in Italy during the 15th and 16th centuries is unsurpassed. Many rich silk fabrics of this period can be seen in the wall cases of the Textile Galleries, Second Floor.

LESS-USED FIBRES

Sheep's wool, and linen are the basic fibres of Europe, while cotton and silk are the principle imported fibres, but there are many others that have played their part in the past, and some that are of considerable importance to-day. Textile fibres fall into the three divisions, animal, vegetable and mineral. Sheep's wool is definitely the most important of the animal fibres, but the wool and hair of almost every other animal has been made into textiles at some time or other. Silk is of course also an animal fibre, and although the silk reeled from cultivated silk worms has always been the most commercially important variety, the cocoons of many wild and semi-domesticated silk-making caterpillars have been used in many places from ancient Greece to Madagascar, and to-day are in demand throughout India and China.

In North America animal sinew, porcupine quills and strips of fur have been extensively used for textile purposes. Many articles made from these materials can be seen in the Ethnographical Galleries, Ground Floor.

In the vegetable kingdom there are the three varieties of fibre, seed-hairs, bast and leaf fibres. Besides cotton, kapok is the one other seed hair that is important commercially. It comes from the seed pods of a large tree, many species of which grow in different parts of the tropics of America, Asia and Africa. It is possible to spin kapok, but the fibres have such a smooth surface that it is not easy, and has never been widely done. In addition to its value for fibre, kapok was widely used for pillow stuffing in ancient times, and serves a similar purpose to-day. Due to its extreme lightness and buoyancy it is now also frequently employed in life saving-equipment. It was used by the natives of the interior of Brazil to tip their blow-gun darts, examples of which can be seen in the South American Gallery, Ground Floor.

There are many other bast fibres besides flax. One of the most important, hemp, probably came originally from near the Caspian Sea, and is now grown widely in Russia, and in parts of southern Europe and North America. The plant is much taller than flax, eight feet being its normal height. Hemp has been used in many of the beautiful handwoven fabrics from Romania that are in the Museum's textile collection, but we usually think of coarser materials in connection with it. It was frequently used for sacking, though jute, which is also a bast fibre, has now largely supplanted it for this purpose. Jute is grown in enormous quantities in India and is a very cheap, but weak fibre. Manila hemp, which is native to the Philippine Islands, is one of the strongest fibres and is used extensively for ropes and cords. Ramie, a plant of the nettle family, which is also known as China grass, is another common bast fibre, but does not compare in usefulness with flax, hemp and jute. The Chinese have cultivated and used it from early times, but the difficulty of preparing it has limited its importance. The bast fibres from many different plants are used by the Indians of North America. The nettle family provided material for many of their finer textiles, and bast from slippery elm and basswood trees was particularly used in this part of the country. the inner bark was cut in long strips, boiled in lye and then dried and shredded. Examples of both fine threads and heavy rope twisted by hand from fibres prepared in this way can be seen in the Ontario Gallery, Ground Floor.

On the west coast of Canada the cedar tree was used by the Indians for everything from totem-poles to textiles. The figures in the group case in the British Columbia room are clothed in garments made from the bark of this tree.

The leaves of many plants provide fibres for textile uses. Most are used only in the districts where they grow but some, like sisal, the material from which so much heavy twine is made, have a wider field. Some beautiful examples of Pina Cloth, made in the Philippine Islands from the leaf of the pine-apple plant, are in the Museum's collections. The leaves of various types of palm trees were extensively used in Africa and some of the islands near New Guinea. Fine fibre cloths from these districts can be seen in the African and Pacific Galleries. An examination of these fabrics shows that the individual fibres are tied together and are not as a rule spun in any way. Examples of fine knitted lace made of palm fibre in the Azores and the Canary Islands, are also in the Museum.

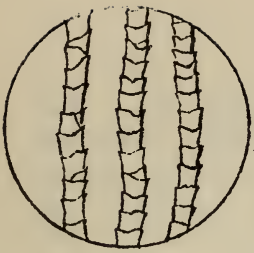
Fibres of mineral origin are less important than those derived from animal and vegetable sources. However, metal fibres are very spectacular, and gold and silver threads have played a large part in the more elaborate productions of the loom, as can be seen by the sumptuous woven and embroidered fabrics shown in the Textile Gallery #17 on the Second Floor. The Field of the Cloth of Gold was so called because the costumes, tents and horse-trappings of Henry VIII, Francis I and their followers were made of silk, richly worked with precious metals. Materials that that were used at that period are among those exhibited. Few fabrics made with pure gold threads have come down to us, since the metal content was so valuable that it was often reclaimed by burning the textiles, however fabrics containing the less valuable silver and silver gilt threads have survived fairly commonly in both European and Oriental weaving and embroidery.

Asbestos is also a mineral fibre. It is a fibrous rock, some varieties of which can be spun and woven into cloth. Its main use, of course, is in the control of fire, for it is not inflammable. The properties of asbestos were known to the Greeks and Romans and its fibres were occasionally used by them for weaving.

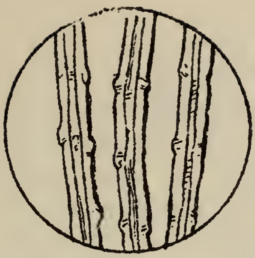
Textiles made of glass have been greatly developed in recent years but are not an entirely new idea. For example, some small samples of fabrics of finely spun glass, made as an experiment during Queen Victoria's reign, are in the Museum.

SYNTHETIC FIBRES

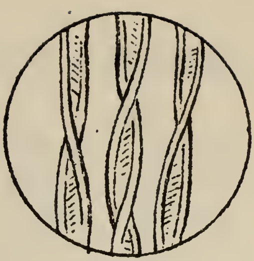
Through the middle part of the 19th century, experiments were made with the production of synthetic fibres, but it was not until 1884 that Count Hilaire de Chardonnet's attempts were successful. The new material was at first called artificial silk, but the name was later changed to rayon. There are four varieties of rayon now in general use; nitro, which is the type Chardonnet invented; cuprammonium, often called bemberg; viscose, which is by far the most important variety; and acetate. In general they are all made from cellulose material like wood pulp, which is converted into a liquid state and then forced through tiny openings called spinnerettes. As the liquid emerges from the spinnerette, it is hardened, making a long unbroken filament very like silk in form. It was not until well on in the 20th century that the quality of synthetic fibres was improved sufficiently for them to rival the natural products in usefulness and beauty. Nowadays this field is widening out rapidly and new types of synthetic fibres are being developed, which have more and more of the advantages of the natural fibres and fewer of the disadvantages. Possibly in the future, filaments of synthetic origin, will not only rival the older animal and vegetable fibres in importance, but may supplant them entirely.



Wool



Flax



Cotton

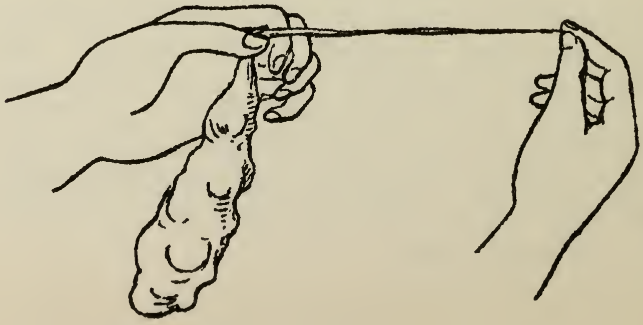
SPINNING

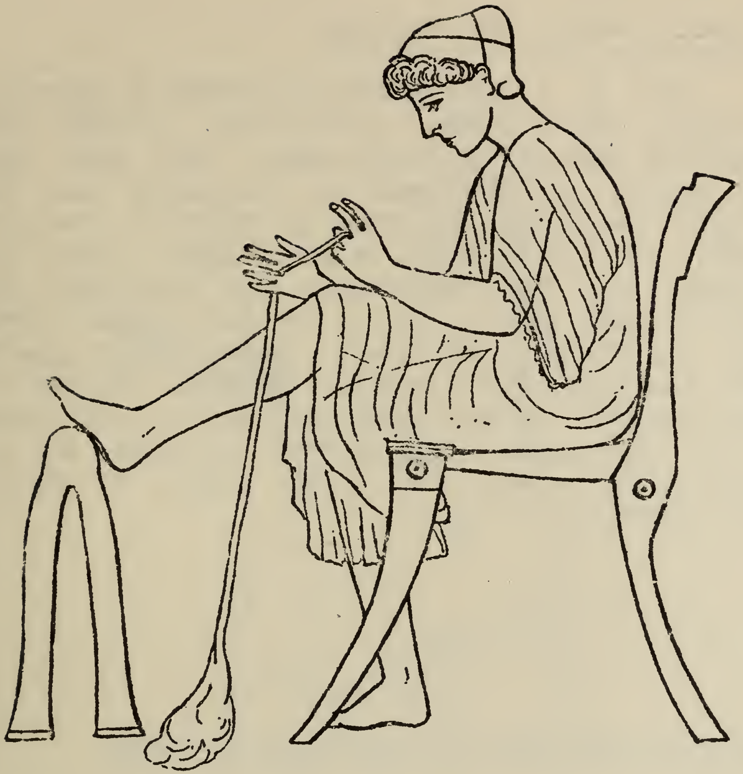
With most textile fibres man is faced with the problem of joining together many short fibres to make a thread. This is done by means of spinning, in which the individual fibres are twisted until they cling together and form a unit. The drawings above of wool, flax and cotton fibres greatly magnified, show the rough texture which helps to make the various fibres stick together. In all spinning there are three operations to be performed; the fibres must be pulled or drawn out to the required fineness and length, they must be twisted together to give them strength and when they are thus twisted into a thread it must be rolled into a ball or on to a spool. In the most primitive types of spinning, these three actions are separate; in the improved spindle spinning, drawing and twisting can be accomplished at the same time; while in the most advanced type of wheel spinning the three actions are performed simultaneously.

During the course of the world's history, spinning has gone through many phases, and improvements in technique have been made from time to time, but the older more primitive methods often survive and continue to be used long after better methods have been discovered. The main ways of spinning by hand are described on the following pages.

Spinning by Hands Alone

This is the simplest form of spinning. The fibres are drawn out between the hands, twisted and then rolled into a ball with no other means then the hands. The whole idea of spinning can be grasped quite easily by anyone who tries out this method. Ordinary cotton batting can be used for an experiment. Take a small wad of the cotton batting and holding it in one hand, pull out a little cotton with thumb and fore-finger of the other hand, then twist the pulled out cotton fibres either to right or left. You will find that in this way you have produced a short length of thread, and that the twist has made the fibres cling together in such a way as to give the thread considerable strength. The cotton that is used to make batting has too short fibres to be really suitable for spinning, so this experimental thread could never by very fine or very strong, but it will show the pulling and twisting, which is the underlying principle of all types of spinning. The quality of a thread is governed by five factors: the fineness, the strength and the length of the individual fibres used, the amount that they are pulled out, and the amount they are twisted in the spinning. Different qualities of fibres are suitable for different purposes, but often the same fibre can be spun loosely if a fluffy yarn is desired, or can be drawn out more and twisted harder to produce a strong, fine yarn.





Spinning by Rolling the Fibres Against the Leg

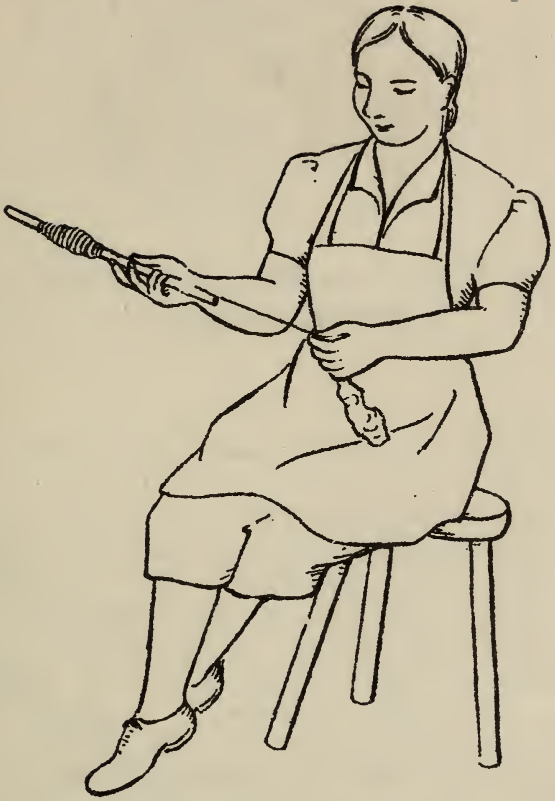
Working with the hands alone is very slow and it is difficult to spin an even thread. An improvement in technique is made by rolling the fibres against the leg instead of twisting them by hand. The illustration above shows a Greek woman of the 5th century B.C. spinning in this way. The method was often used to make the fibres into a long, loose roll called a roving, which was later re-spun into a finer, harder thread. On page 5 the central figure is preparing a roving from flax fibres in this way and it is then being re-spun by the standing figure on the right.

Spinning with a Hooked Stick

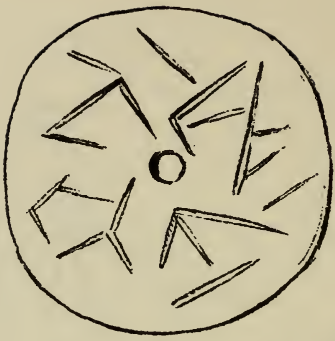
This is a very primitive method of spinning. A stick with a natural crook to it is held with the hook down in the right hand. The spun yarn is rolled on the shank of the stick and the fibres ready for spinning are held in the left hand. The stick is twirled between thumb and fingers of the right hand and the hands are slowly drawn apart, while the left hand feeds out the fibres, which are caught up and spun by the twisting of the stick. This is an easy but slow method and the resulting yarn is not likely to be very good. The method survives to the present day among some of the nomads of the Red Sea district.

Spinning with Spindle Twirled in the Hand

This produces better yarn than any of the last three methods described. A small, straight stick or spindle is held in the right hand with the wool that has already been spun wound on it. The left hand holds the fibres ready for spinning, and feeds them into the thread, while the spindle twirling in the right hand puts the twist in them. As the spindle twirls the spinner's two hands are drawn apart, which stretches and twists the wool simultaneously. The illustration on page 23 shows a Macedonian woman, now resident in Canada, spinning in this way. The method is also still used by various tribes in Egypt and the Sudan. It is easier to twirl the spindle when a weight of spun wool is wound on it, so frequently a



permanent weight of stone or wood or some other solid material is added to the spindle. This weight is called a whorl, and many examples of ancient spindle whorls from various parts of the world are in the collections of the Museum. Drawings of a number of them can be seen on page 32.

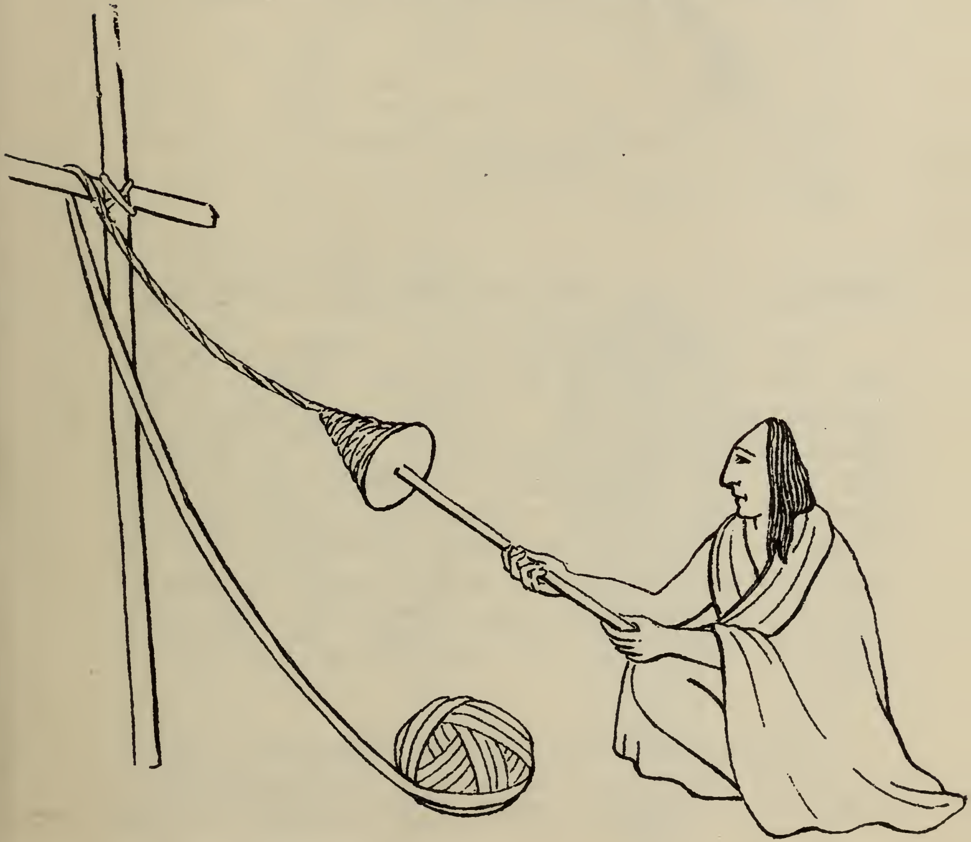


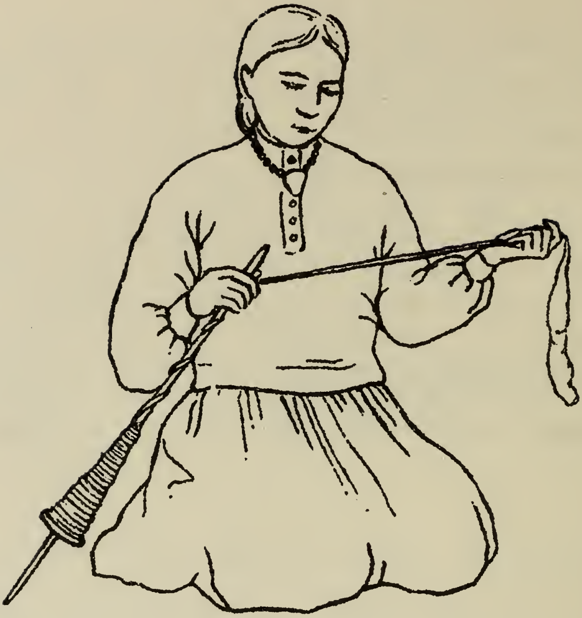
Large wooden spindle whorl.
British Columbia.

Spinning with the Spindle Grasped in Both Hands

For this method the fibres are first twisted by hand into a long loose roll which is called a roving. The roving is flung over a high beam and is then attached to the upper arm of the spindle near the whorl. The drawing on the opposite page is taken from one of the Paul Kane paintings in the Museum, and shows this method of spinning as used by the Salish Indians on the coast of British Columbia. Incidentally it also shows the curious deformation of the head which was practised by these Indians. The spinner squats on the floor holding a very long spindle with a huge spindle whorl, at an angle in front of her. With a sort of tossing motion she tworls her spindle, twisting the length of roving which is between the end of the spindle and the beam. When it has been sufficiently twisted it is wound on the spindle just above the whorl and another length of roving is drawn over the beam by swinging the spindle backward. In the British Columbia Gallery, Ground

Floor, large whorls used in this type of spinning can be seen in one of the table cases, also samples of the spun wool in a heavy white blanket and the tassels on some of the wooden rattles. British Columbia is one of the very few places where this grasped spindle method has been used for the spinning of a single thread. It is much more satisfactory for twisting threads together to make heavy two or three ply yarn and has been used more widely for this purpose. It was used in this way in ancient Egypt and in more recent times in Spain.



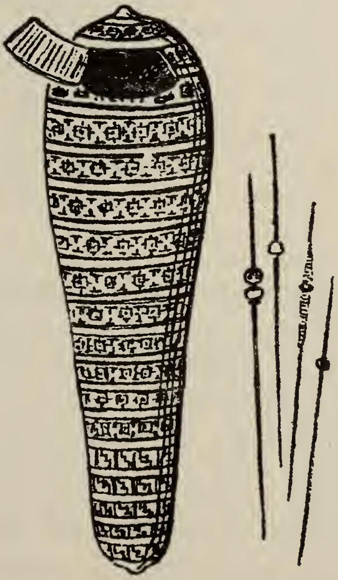


Spinning with the Spindle Supported in Some Way.

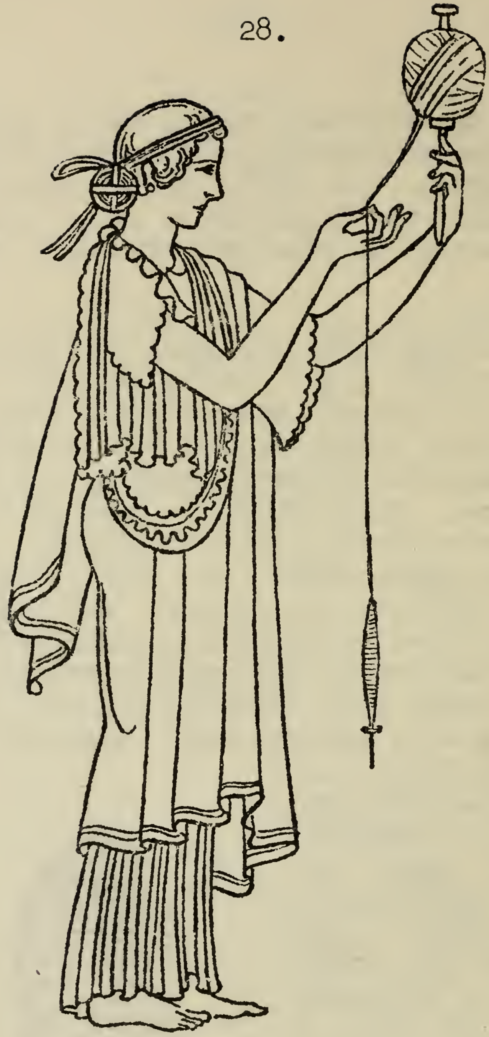
The drawing above shows the method of spinning used by the Navaho Indians in the southwestern United States. A rather long spindle is placed point down on the ground, and is twisted with the right hand, while the left pulls out the fibres as the spindle twists them. This process is repeated twice. The first spinning serves to twist the carded fibres into a rough, loosely spun roving, while in the second spinning this roving is further pulled and twisted into fine yarn.

Spinning with the spindle supported in some way can be done in a number of different ways. In North Africa the worker squats on the ground in much the same way as the Navaho Indians, but instead of placing the spindle point down on the ground, the shaft of the spindle is laid against the thigh and is rolled over and over from hip to knee with the palm of the hand.

In India, when spinning the very fine cotton threads for Dacca muslin, a small spindle was placed upright in a bowl, and was spun like a top, while the two hands of the spinner controlled the pulling out of the fine fibres. This method was used in several places in the world, including Peru, where very fine cotton thread was spun in ancient times. The Peruvian spinners moistened the fibres with saliva frequently while spinning, to make them stick together more readily. An exhibit in the South American Gallery, Ground Floor, shows a pottery case, which is about ten inches long, containing the very fine lightly weighted spindles used for cotton spinning in Peru before the Spaniards came. There is also a spinner's basket with rolls of thread, spindles and combs which were probably used in cleaning the fibres. In the adjoining room can be seen many beautiful woven fabrics which show the fine cotton and wool spinning done in Peru centuries ago.

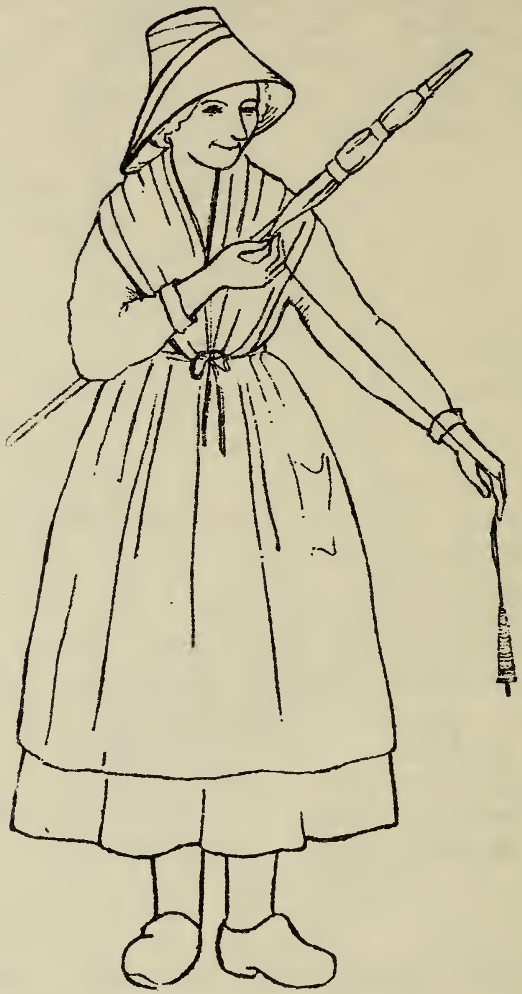


Peruvian, c. 1000 A.D.



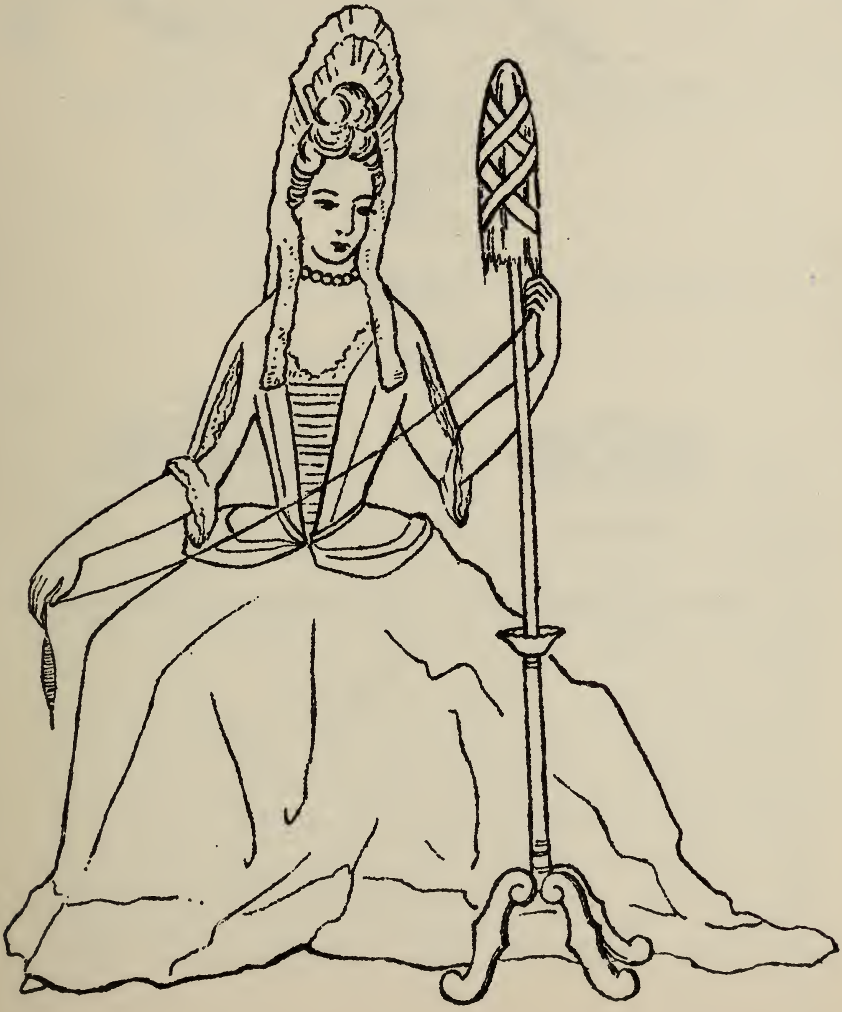
Spinning with the Spindle Suspended in the Air

Suspended spindle spinning is the most nearly perfect method devised before the spinning-wheel was invented. By it, a fine, even thread can be produced considerably more rapidly than by any other way of using the hand spindle. The spun yarn is wound on the spindle close to the whorl and is fastened at one end of the spindle with a half hitch knot. Sometimes for this method of spinning the spindle is made with a notch or hook at the end in which the thread can be caught. The spindle is twisted and dropped so that it hangs quite free, twirling in the air, spinning the fibres together, while they are pulled out by the hands, and also by the weight of the spindle itself. When enough yarn has been pulled out and spun for the spindle to be almost touching the floor, it is picked up, the spun yarn is rolled on it, and the process is repeated. The ancient Egyptians often used this method of spinning. When they did they always made their fibres into a roving which they rolled in a ball and put in a bowl behind them. The spinner in the Egyptian relief shown on page 5 is spinning two threads at a time, a feat that was only possible when the rovings were well prepared. She is about to roll one spindle hard against her raised thigh while the other spindle has been dropped and is twirling in the air. The figure on the opposite page shows the manner in which the ancient Greek women spun. They used the dropped spindle method and like the Egyptians, prepared their fibres with a preliminary spinning. The Greeks made a roving by rolling the fibres against the leg as shown in the drawing on page 21, then tied the roving to a distaff which was held in the left hand. In Europe from classical times onward, the distaff was frequently added to the spinners' equipment. It became such a usual part of a woman's possessions that the maternal branch of the family was referred to legally as the "distaff side", while the paternal was known as the "spear side". The distaff could be just a plain stick to which the prepared fibres were tied, but frequently it was more elaborate. It was usually either stuck through the spinner's belt, or tucked under the arm on the left hand side, and in this way both

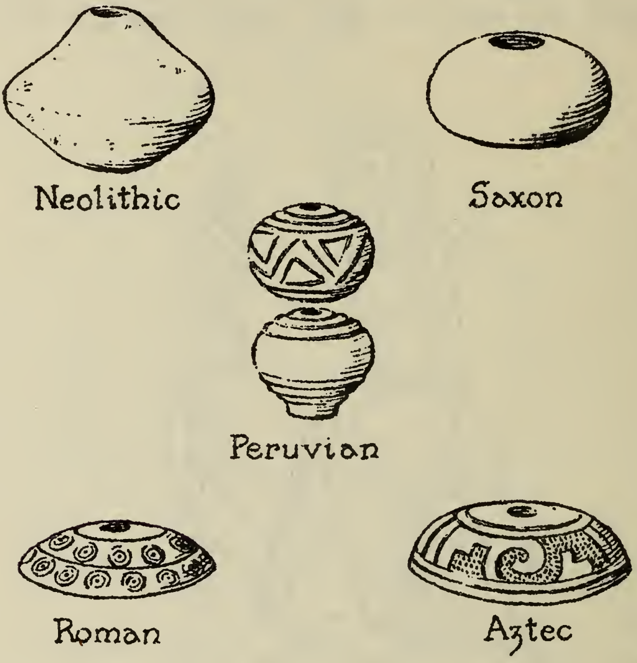


hands were freed to manipulate the fibres and the spindle. The drawing above of a Breton peasant shows the usual technique. Sometimes the distaff was in the form of a tall pole on a stand which was called a "rock".

The drawing below is taken from a late 17th century print and shows a fashionable lady of the period seated spinning with the dropped spindle method and drawing her fibres from a rock. The small cup part way down the shaft was to hold water to dampen the fingers when spinning flax, as the fibres are much more flexible and easy to work when they are wet.



With an art as wide spread as spinning there were, of course, many variations of method among different peoples, but all of them seem to fall under the heading of one or other of these general methods.



Neolithic

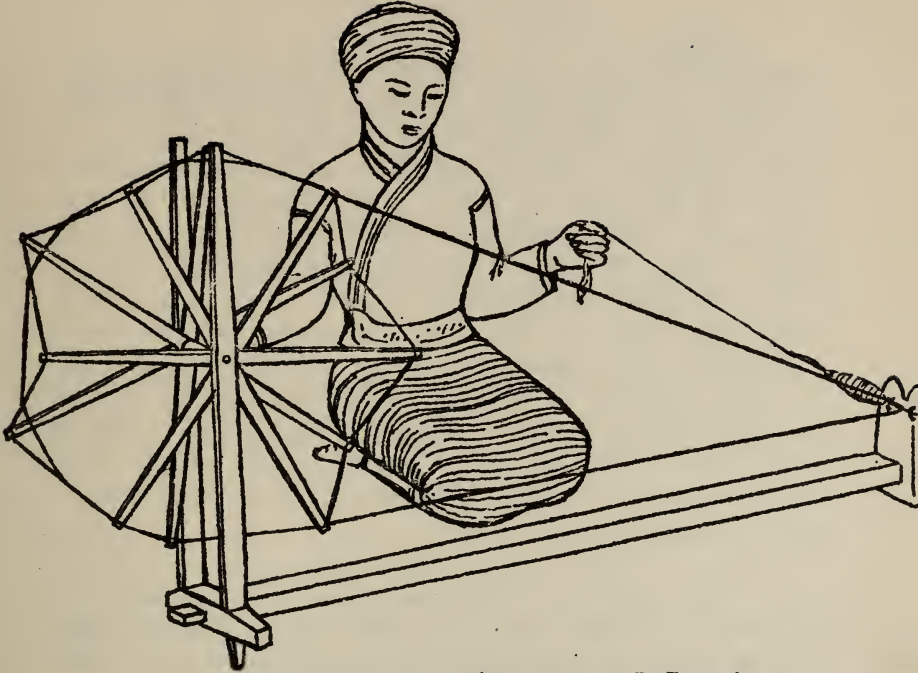
Saxon

Peruvian

Roman

Aztec

Spindle whorls of clay, stone and bone

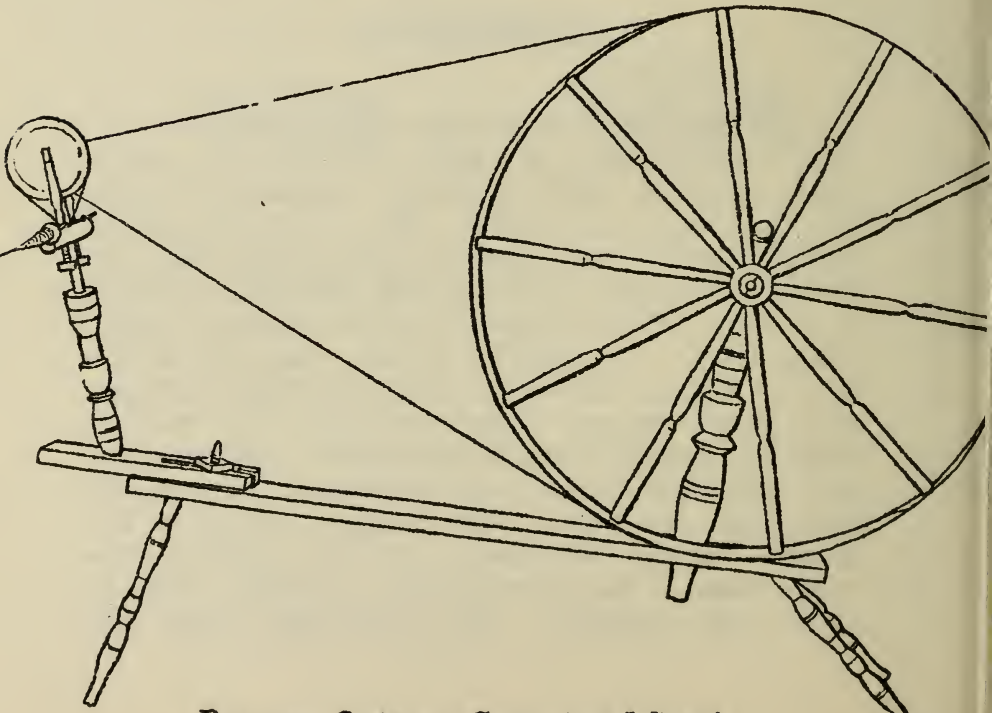


Indo-Chinese Spinning-Wheel

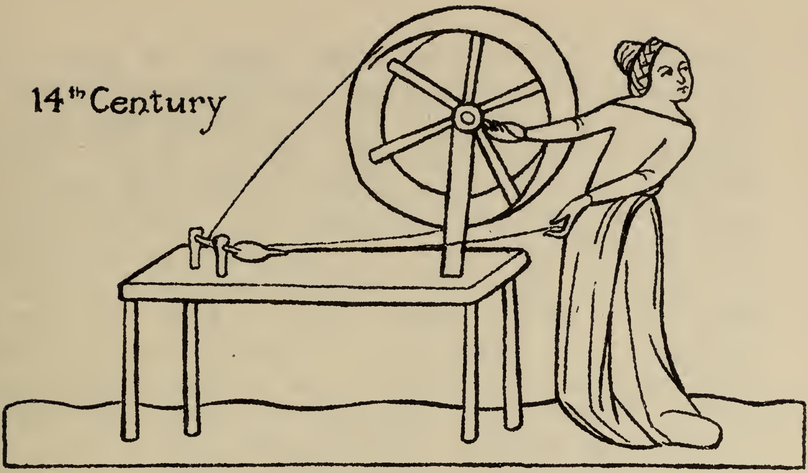
SPINNING-WHEELS

It was sometime between 500 and 1000 A.D. that the spinners of India started to use a wheel to twist their spindles, instead of doing all the work by hand. The earliest Indian spinning-wheel was very like the modern one from French Indo-China shown in the drawing. A model of a wheel of this type is in the Museum's study collection. The wheel itself consists of two sets of spokes joined by criss-crossing strings. Over these strings a driving belt runs encircling the spindle, which is mounted horizontally, at a little distance from the wheel. To operate this type of wheel the spinner squats on the ground beside the wheel, turning it with the right hand. The spun thread is wound lightly round the spindle. The left hand holds the prepared fibres, or roving, out to the left almost in line with the spindle, so that when the spindle is turned by moving the wheel, a twist is put in the section of roving between the tip of the spindle and the hand of the spinner. The spinner's hand is slowly drawn away extending the fibres as they are spun, then the hand is brought in at right angles to the spindle, so that the next turn of the wheel rolls the spun yarn on to the spindle, and then the process is repeated. Although spinning can be done considerably faster with this wheel than with the spindle held in the hand, the twisting and rolling processes are still separate actions.

This type of wheel spread from India to China and Japan and is used right down to the present day in many districts of the East. The



Pioneer Ontario Spinning-Wheel

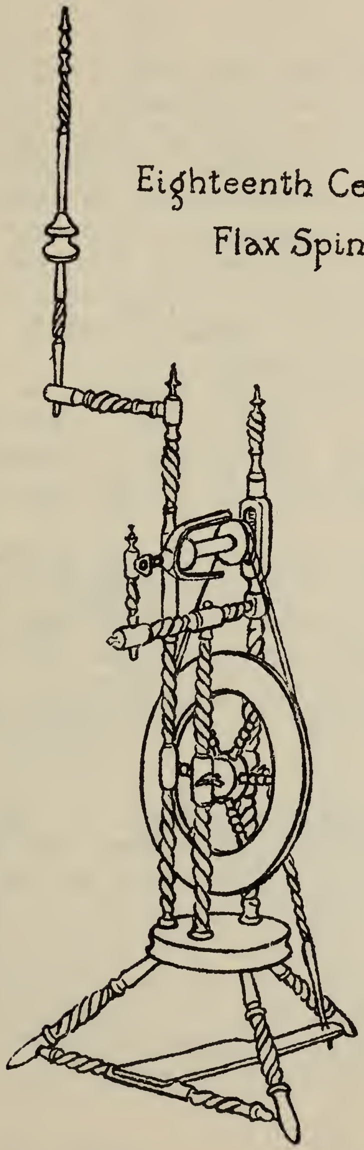


knowledge of it also spread west to Persia and finally to Europe. The first written record of a spinning-wheel in Europe is from the end of the 13th century, and the first picture of one is in an early 14th century manuscript in the British Museum. The drawing above is taken from this manuscript. It shows that the European version of the spinning-wheel was much the same as the eastern, except that the wheel had a solid rim and was raised so that the worker could either stand or sit on a stool to work, instead of squatting on the ground.

This simple spinning-wheel was quick in operation, but the fibres had to be very carefully prepared for spinning. The great wheel that was used so widely for wool spinning in this country in the early days, was the direct descendent of the earliest spinning-wheel, and the method of operating it was exactly the same as that described above, except that the worker stood and in order to get a long draw walked backwards and forwards while she was spinning. The illustration on the opposite page is of an Ontario wheel of pioneer times, which is in the Museum. It shows the one mechanical improvement that was made on the older wheel; a small wheel was added, the belt from the large wheel turning it, while a short belt from it turned the spindle, thereby multiplying the speed of the turning spindle. The tension of the large belt can be adjusted by moving the front arm, and the smaller belt can be loosened or tightened by screwing up or down the pegs on which the small wheel is mounted. These wheels were called the "Great" "Muckle", or sometimes "Jersey" wheel, and were widely used, particularly for wool spinning, until fairly recent times in America and the British Isles, and many of the European countries. The pioneer women in this country often walked many miles a day backwards and forwards spinning wool on their great wheels for clothing and coverlets.

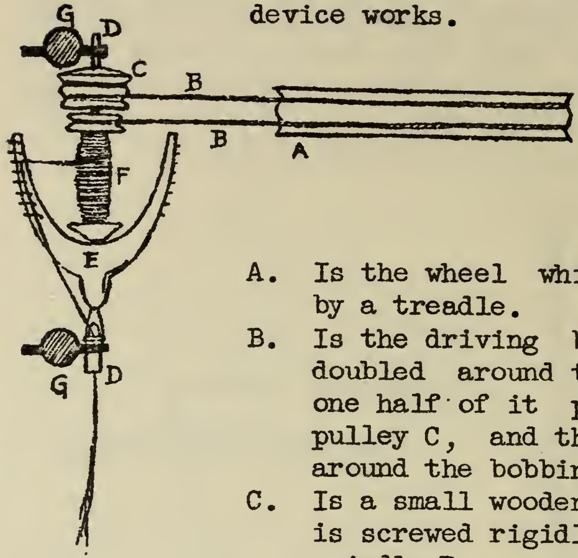
Although this fairly simple type of wheel was widely used until well on in the 19th century, a much more complicated and efficient type was invented nearly 500 years ago. The important invention was a flyer which spun the fibres simultaneously with the rolling up of the yarn. About this same time a foot treadle to drive the wheel was also introduced, which left both hands free to feed the fibres onto the twirling spindle. The additions of flyer and treadle made a wheel which was speedy in operation and which was well suited to the spinning of both wool and flax. It was not superseded until the time of the Industrial Revolution.

The first picture that we have of the new flyer attachment on a spinning-wheel is in a German book of about 1475. Among Leonardo da Vinci's many sketches of mechanical inventions there are several of spinning machines very similar to the newly developed type and some authorities consider that, along with his many other accomplishments, he was the inventor of this revolutionary idea in spinning. However it seems more likely that he was simply trying to improve on the invention, and that it was actually made some years before his time by an unknown genius. The drawing below shows an 18th century flax wheel with the flyer attachment, which is in the Museum collection.



Eighteenth Century
Flax Spinning-Wheel

This diagram shows how the flyer device works.



A. Is the wheel which is turned by a treadle.

B. Is the driving belt which is doubled around the wheel, and one half of it put around the pulley C, and the other half around the bobbin F.

C. Is a small wooden pulley which is screwed rigidly on to the spindle D.

D. Is the spindle, a long steel shaft with a thread towards one end on which the pulley is screwed and the other end widening into a tube with openings at either end.

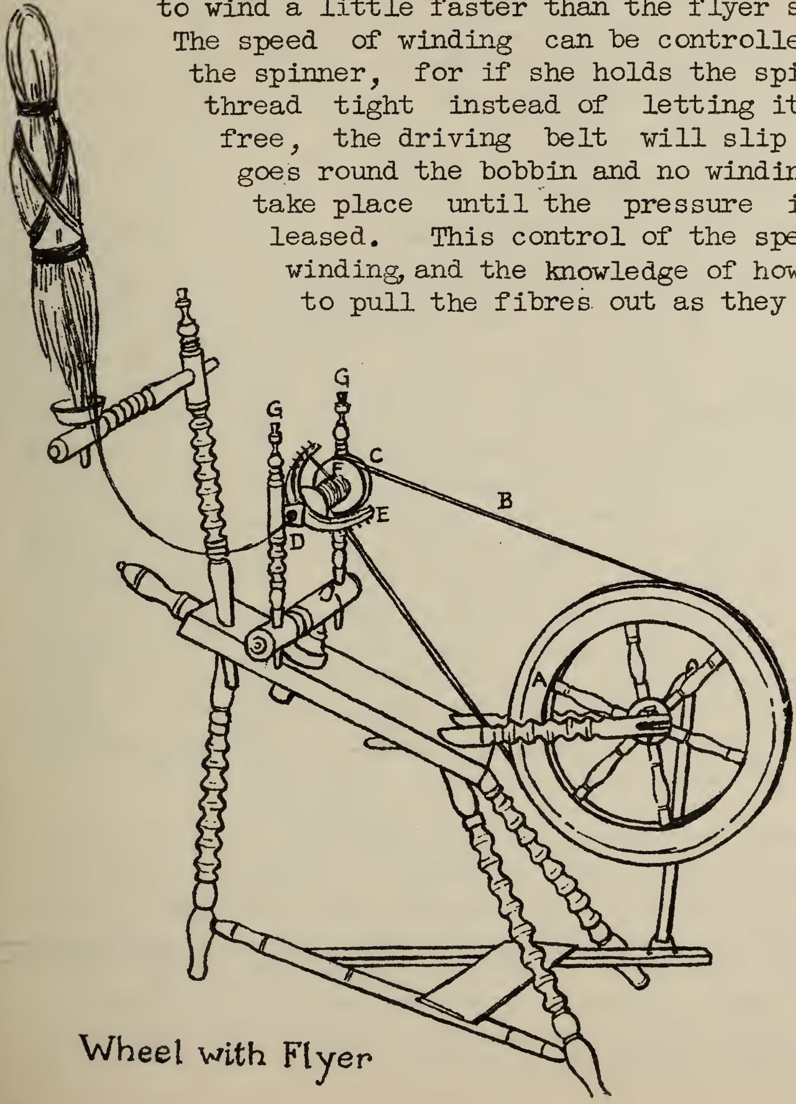
E. Is a wooden flyer which is mounted rigidly on the spindle. It has two arms on each of which is a row of small metal hooks.

F. Is a bobbin running loose on the spindle between the flyer and the pulley.

G. Are the two upright posts which support the spindle.

The spun yarn is rolled on the bobbin (F) and brought over a hook on one arm of the flyer (E), and then through the tube at the end of the spindle (D). When the wheel (A) is turned, the driving belt turns the bobbin (F), and also the pulley (C), which, as it is mounted rigidly on the spindle, also turns the spindle (D), and the flyer (E) which is attached to it. As the flyer turns it carries the yarn round with it, and the twist thus put on it runs through the tube at the end of the spindle and up the fibres which are held in the hands of the spinner, spinning a thread at the same time that the turning bobbin rolls the thread up.

The diameter of the bobbin is always smaller than that of the pulley, which makes the bobbin turn slightly faster than the spindle with the flyer. It is this difference in speed that makes it possible for the bobbin to wind a little faster than the flyer spins. The speed of winding can be controlled by the spinner, for if she holds the spinning thread tight instead of letting it run free, the driving belt will slip as it goes round the bobbin and no winding will take place until the pressure is released. This control of the speed of winding, and the knowledge of how much to pull the fibres out as they spin,

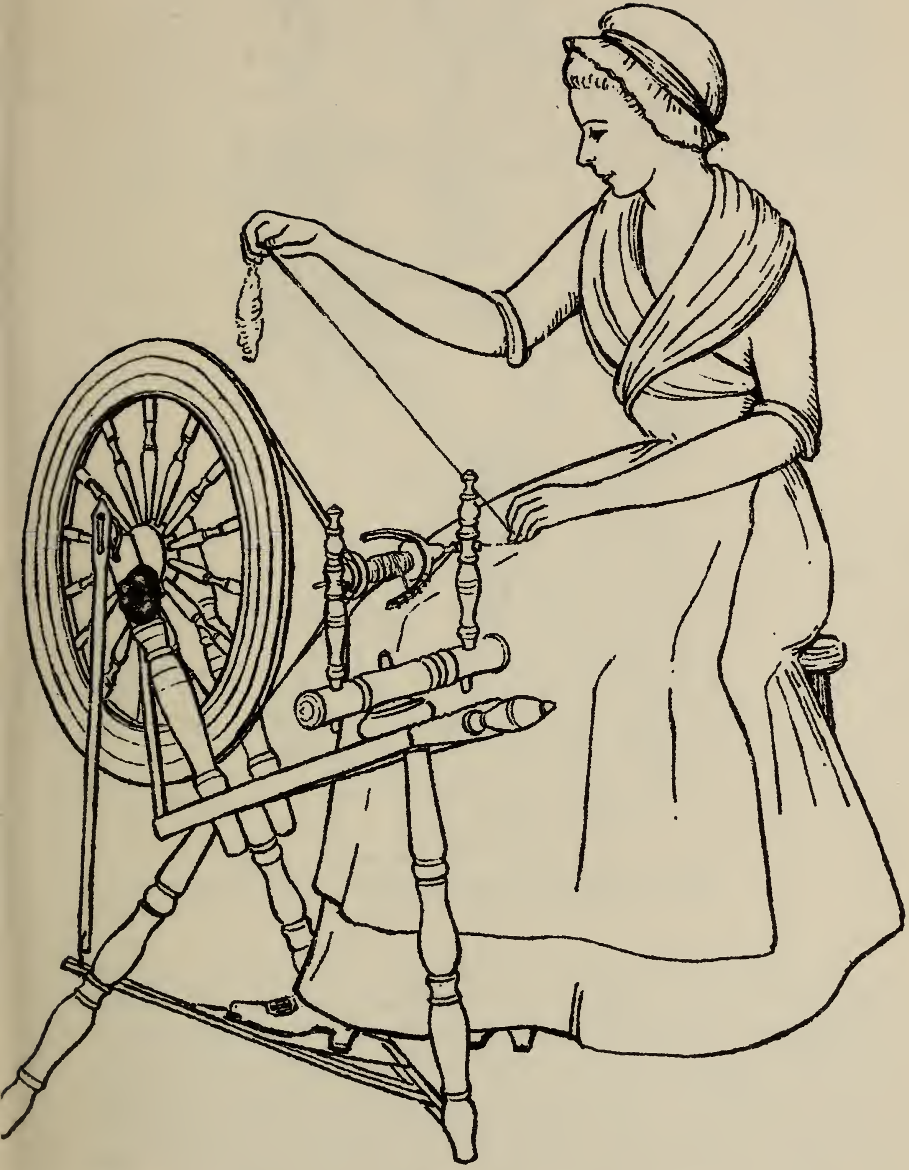


Wheel with Flyer

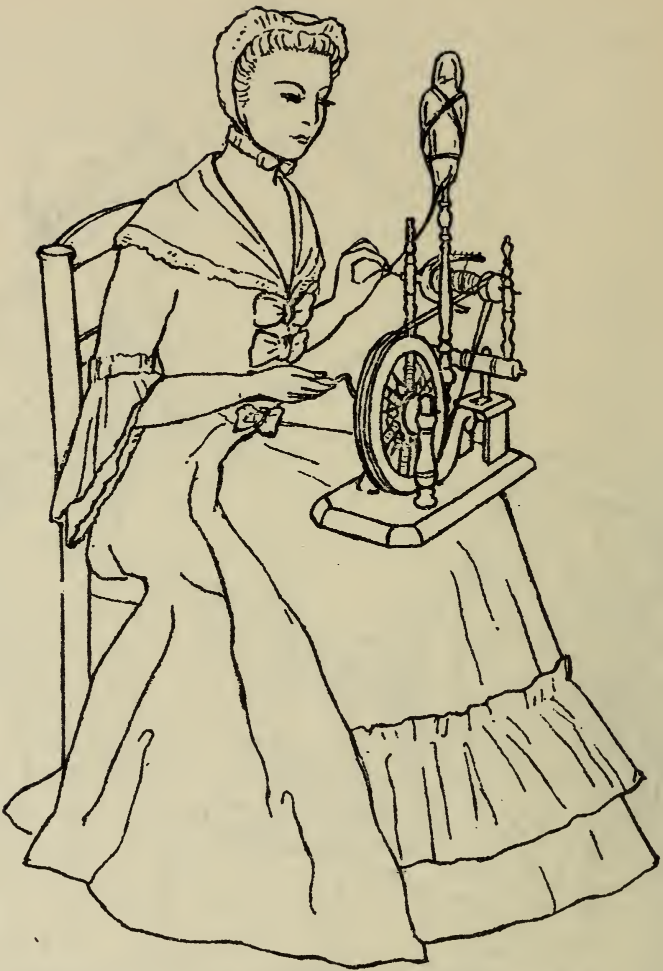
are the two essentials of spinning with this type of wheel, and they can only be learned with a good deal of practice. The speed of winding can also be increased by moving the arms (G) on which the spindle is mounted back, thus tightening the driving belt. This makes the belt slip less as it turns the bobbin and the bobbin runs faster.

The drawing on page 39 is of a Bavarian Flax wheel which is quite small and light. Spinning-wheels of the flyer type, however, are made in many sizes, and the wheel is placed at all angles to the spindle from horizontal to vertical. The drawing on the opposite page shows a much heavier type which has the wheel mounted horizontally to the spindle. It is an early 19th century New England spinning-wheel, which could be used just as well for flax as for wool. The illustration shows the method of using these wheels for wool. The left hand is held close to the opening of the tube at the end of the spindle, and the right hand holds the carded wool. As the wheel is set in motion by treadling with the left foot, the bobbin starts to roll up the yarn and the flyer twirls, spinning a twist into it. The spinner allows the twist to run up into the fibres she is holding between her hands, then pinching the yarn firmly with the fingers of her left hand near the spindle, she pulls back with her right hand stretching the fibres out finely, as the twist goes into them, then she lets that length of spun yarn roll up on the bobbin and repeats the process. The yarn is put over each hook on the flyer in turn so that the bobbin is filled evenly with the spun yarn.

The work goes quickly and when well done the motion is beautiful to watch. Spinning particularly during the 18th century, was considered a very attractive occupation and the more elaborate wheels were made for the drawing room, where they were used, rather as a pretty toy for the fashionable lady, than as a necessary means for procuring thread for household purposes.



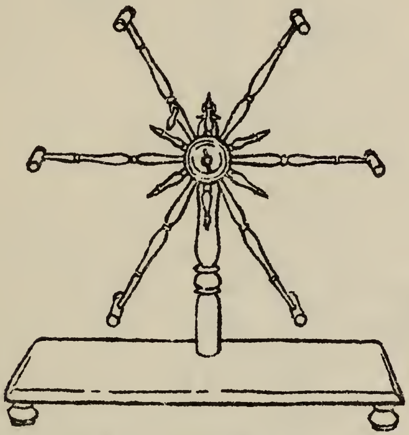
New England Spinning-Wheel – Early 19th Century



Flax Spinning-Wheel – 18th Century

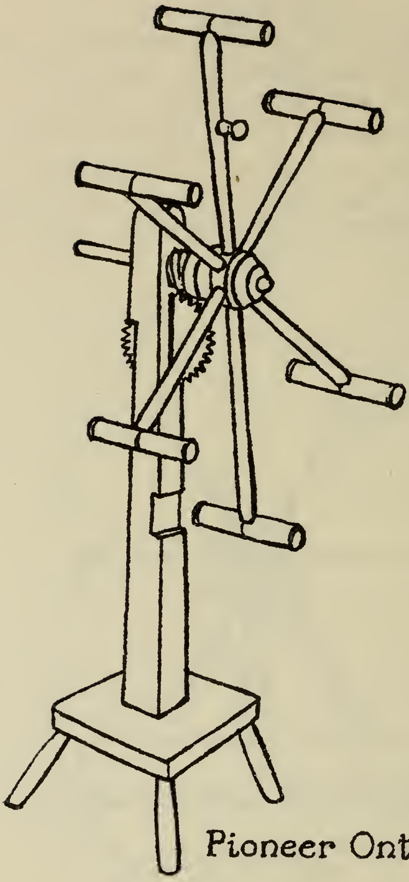
A light wheel of the drawing room type, which would have been used for spinning flax, is shown on page 37. The method of spinning flax is different from that used for wool. The fibres are tied to the distaff, which is a detachable part of most of these wheels; one hand pulls the fibres out of the mass on the distaff while the other guides them into the nozzle of the spindle. Flax is always spun with the hands wet and a small cup is often attached to the distaff to hold water for this purpose.

Sometimes the spinning-wheels were on a really small scale like the one in the illustration on the opposite page, which is in the Museum's collection. An 18th century lady is shown spinning with it. She holds it on her lap and turns the small wheel with her right hand as she draws and controls the flax with her left.



18th Century Reel.

Single strands can be doubled and tripled into two and three ply yarn very easily with a spinning wheel. Ends are taken from the required number of balls of single ply yarn, are threaded through the spindle, over the hooks of the flyer and on to the bobbin together. The wheel is then put in motion, and as the single threads are wound up on the bobbin, they are twisted together.



Pioneer Ontario Reel

REELS

Wooden reels were used to make the yarn into skeins. The one above is typical of those used in this part of the world during pioneer times. It has a wooden cog wheel that makes a loud click after every 41 revolutions; in this way the length of the skein is measured as it is wound. The small reel shown on page 43 is the type used with the light 18th century drawing room spinning-wheels. Both these examples are in the Museum collection.

THE INDUSTRIAL REVOLUTION

In Europe spinning was predominantly the work of women, particularly the young girls, hence the present legal term for an unmarried woman is a spinster. In early times a household was a self sufficient unit, with all the necessary spinning and weaving being done by its members. However the more elaborate productions of the loom are quite outside the scope of the ordinary housewife, and as soon as really fine fabrics were developed, a class of highly trained craftsmen became necessary to produce them. In spite of the fact that there was a great deal of home production of coarser materials for household purposes, specialization increased as the centuries passed and by mediaeval times the various branches of the textile arts were the work of separate groups of craftsmen. There was also a considerable amount of regional specialization; for example Flanders, and later parts of England became famous for the processing of wool.

The preparation and spinning of yarn consumes a great deal of time, and three or even more people are needed in this branch of work to keep pace with one weaver. This meant that there was a great demand for spinners, so drapers and weavers in the towns started to put out raw wool to be spun by women in the country. The pay was small, but it served as a casual extra revenue in households where the main concern was agriculture. However the system was not entirely satisfactory for whenever the pressure of work in the fields became heavy, the women stopped spinning, causing serious seasonal shortages of spun yarn, which held up the work of the weavers. By the 15th century, this so-called putting-out system for spinning was well established in the textile producing areas of Europe, and was also used to a considerable extend for weaving. This cottage industry involved not only a network of communications, but also some kind of a distributing centre, and was accompanied by a definitely capitalistic control of the textile industry. The gathering of workers under one roof, was tried out in England as early as the 16th century. However, the Tudor government was opposed to this development, and also the craftsmen seem to have much preferred the freedom of working in their own houses. As long as the appliances necessary for spinning and weaving were comparatively simple, there was little incentive to sink large amounts of capital in buildings to house the workers. It was not until the time of the Industrial Revolution that technical conditions were such that the factory became the necessary form of industrial organization.

There are three motions necessary to spinning: pulling out the fibres, twisting them, and rolling them up. The invention of the flyer attachment for the spinning-wheel accomplished the twisting and rolling motions quite mechanically, and power could be applied easily to these processes; but the pulling out of the fibres, which had always been done by hand, was a more difficult thing to do by mechanical means. The successful solving of this problem was, as is so often the case in important inventions, the result of the work of a number of people. During the seventeen thirties Waytt and Paul experimented with a spinning machine embodying a new principle. A carefully prepared roving was run between a pair of rollers and on to a flyer and bobbin very similar to those on a spinning-wheel. The flyer and bobbin performed the same functions of twisting the fibres and rolling up the yarn that they did on the wheel. As the flyer turned, it created a tension on the length of roving stretched between it and the rollers, and this tension pulled the roving out to the degree of fineness required for yarn. The disadvantage of this method was that a terrific strain was put on the fibres before they had been given sufficient twist to strengthen them to withstand it.

In 1769 Arkwright took out a patent on a spinning machine which was a much improved version of Wyatt and Paul's invention. Instead of passing the roving through only one pair of rollers and allowing the strain between flyer and rollers to extend the fibres, he used several pairs of rollers revolving at increasing speeds, so that the roving was gradually extended between each pair. This proved to be much more practical than the earlier invention, and Arkwright set up spinning mills employing the new machines, which were driven by water power and called water frames. In spite of the fact that his patent rights were at first disputed and later disallowed entirely, he had great financial success. Both Wyatt and Paul's Machine and Arkwright's improvement on it, provided a continuous method of spinning by mechanical means, but neither was suitable for spinning fine threads because the strain on the fibres was too great.

At about the same time that the roller spinning was being developed, experiments were made on a different principle, which resulted in 1767 in the invention of Hargreaves' spinning jenny. In the jenny a number of spindles rotating in a vertical position are slowly separated from a frame which holds the spools of roving, thus extending the fibres of the roving stretched between spindles and spools, while the rotating spindles twist them. When the extension and twist are completed, the frame is brought together again, rolling the spun yarn up on to the spindles. The action of spinning and winding is intermittent as opposed to the continuous method of roller spinning. Hargreaves' spinning jenny could not be called a machine for its action was by no means automatic, but it did make it possible for one worker to spin a number of threads at once.

In 1774 Samuel Crompton began working on the most important of the great spinning inventions. After about five years he completed a spinning machine which combined the best features of the jenny and the water frame, and as it was a cross between the two machines it became known as the "mule". It spun with the same intermittent motion as the jenny but used rollers similar to those on the water frame. The mule's great advantage was that the thread was not subjected to any strain until it had sufficient twist and strength to bear it, and as a result very fine yarn could be spun with it.

The jenny was a device that could be owned and operated by individual spinners, so that its introduction did nothing to disturb the set-up of the cottage industry. The same is true of the mule in its initial stages, when it was still comparatively simple, but the water-frame and the more advanced type of mule, with their necessity for the application of power, were only suitable for factory use and their introduction was one of the causes of the development of the factory system. Spinning was the first great industry effected by the new mechanical inventions and cotton was the first raw material processed by them. It was during the period of the Industrial Revolution that cotton assumed its present important place: also at that time England, and particularly Lancashire, became the greatest cotton manufacturing area in the world. In spite of the fact that well before the end of the 18th century there were spinning mills operating on a factory basis with power driven machines, the putting-out system and the cottage industry survived into the 19th century, and a certain amount of hand spinning is even done at the present time.

In modern machine spinning we find both the continuous roller method of spinning, now called the throstle, and the intermittent method of Crompton's mule still used. The former method is suitable for coarse work and the mule is used for spinning the finer yarns. In general machines can accomplish the spinning of fibres neither better nor worse than the hand spinner; their advantage lies simply in their speed which makes possible the modern methods of mass production.

SELECT BIBLIOGRAPHY

Born, W.	The Spinning Wheel. Ciba Review #28.
Crowfoot, G.M.	Methods of Hand Spinning in Egypt and the Sudan. Bankfield Museum Notes, 2nd Series, No. 12.
Kissell, M.L.	Yarn and Cloth Making. The MacMillan Co., 1918.
Usher, A.P.	The Industrial History of England. Houghton Mifflin Co., 1920.
Woolman, M.S. McGowan, E.B.	Textiles. A Handbook for the Student and the Consumer. The MacMillan Co., 1929.
Osburn, B.B.	Homecraft Course in Pennsylvania German Spinning and Dyeing. Schlechter's, Allentown, Pa.